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Introduction

The presented study contributes to the development of decentralized biorefinery concepts (Figure 1) to be applied in the organic agricultural industry in Denmark, by integrating energy production (biogas and bioethanol) in organic farming, increasing the sustainability and energy self-reliance of organic food production systems.
In this work, a method for bioethanol production from rye and wheat grain was developed by utilizing the inherent amylase activity from germination of the seed. Simultaneous Saccharification and Fermentation (SSF) was performed to reduce end-product inhibition of the amylases during ethanol fermentation. Using organic cheese whey as a cheap nutrient source minimized the use of water and chemicals aiming at reduced process costs.

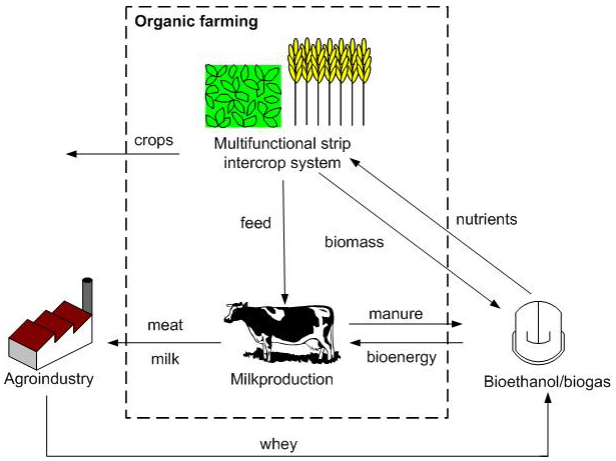
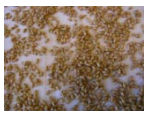


Fig. 1 Concept of bioenergy production in organic farming

The process


germinated grain


whey

Prehydrolyzis

50°C, 24h, pH4.8

↓

Fermentation - SSF

***K. marxianus* DSMZ 7239**

↓

Ethanol

↓

DDGS? ⟵ „Residues" ⟶ Biogas?

Results

- Germinated grain can be used as raw material in bioethanol production by producing in-situ enzymes.
- Nutrient cost for ethanol production could be reduced by using cheese whey.
- The ethanol fermentations were completed by 190 h.
- Rye grain with high AAQ (autoamylolytical quotient) values were found to be suitable for autoamylolytical processes.
- The process is strongly dependent on the efficiency of the germination step.
- Wheat was not found to be a feasible substrate for inherent enzyme production.

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